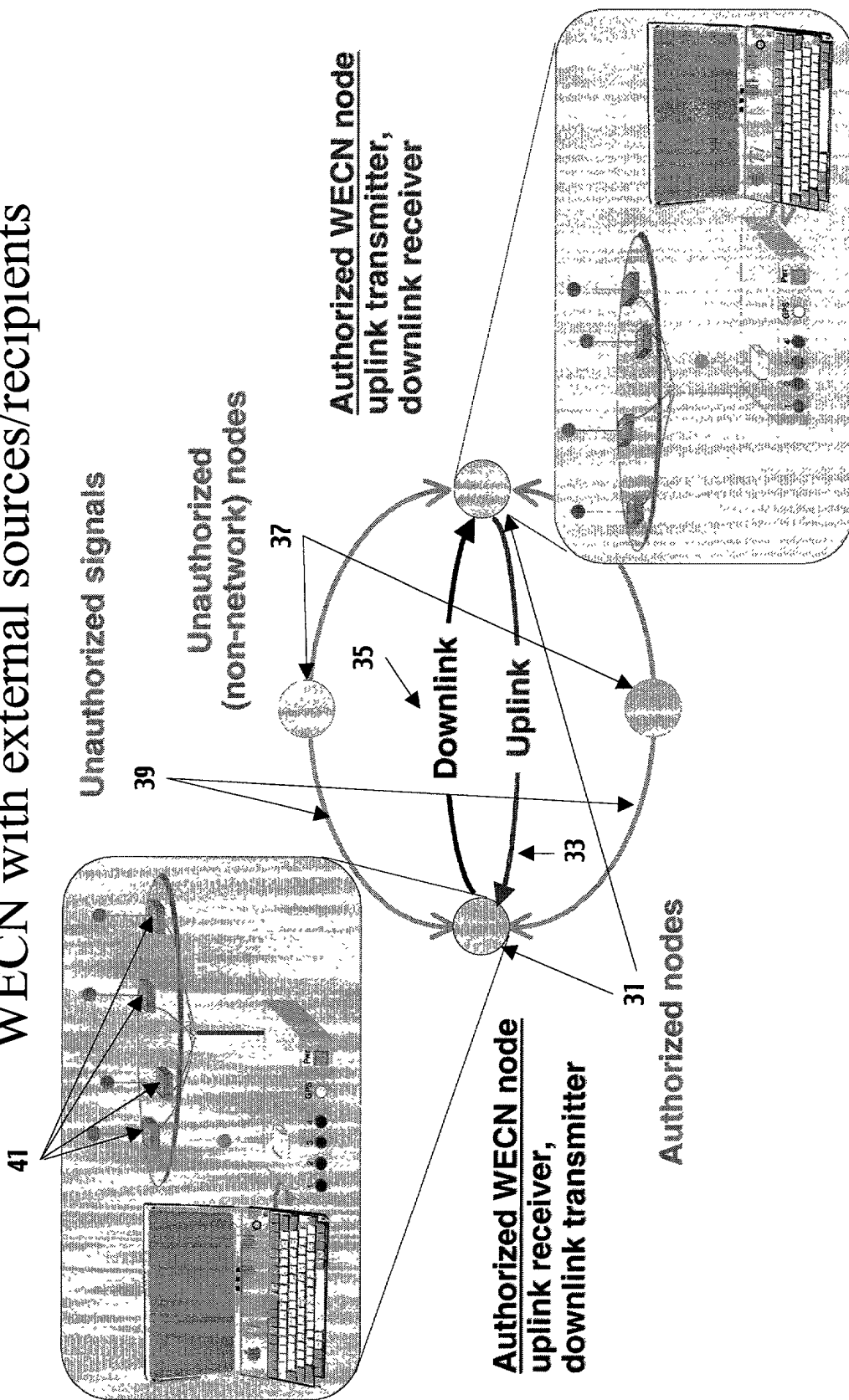


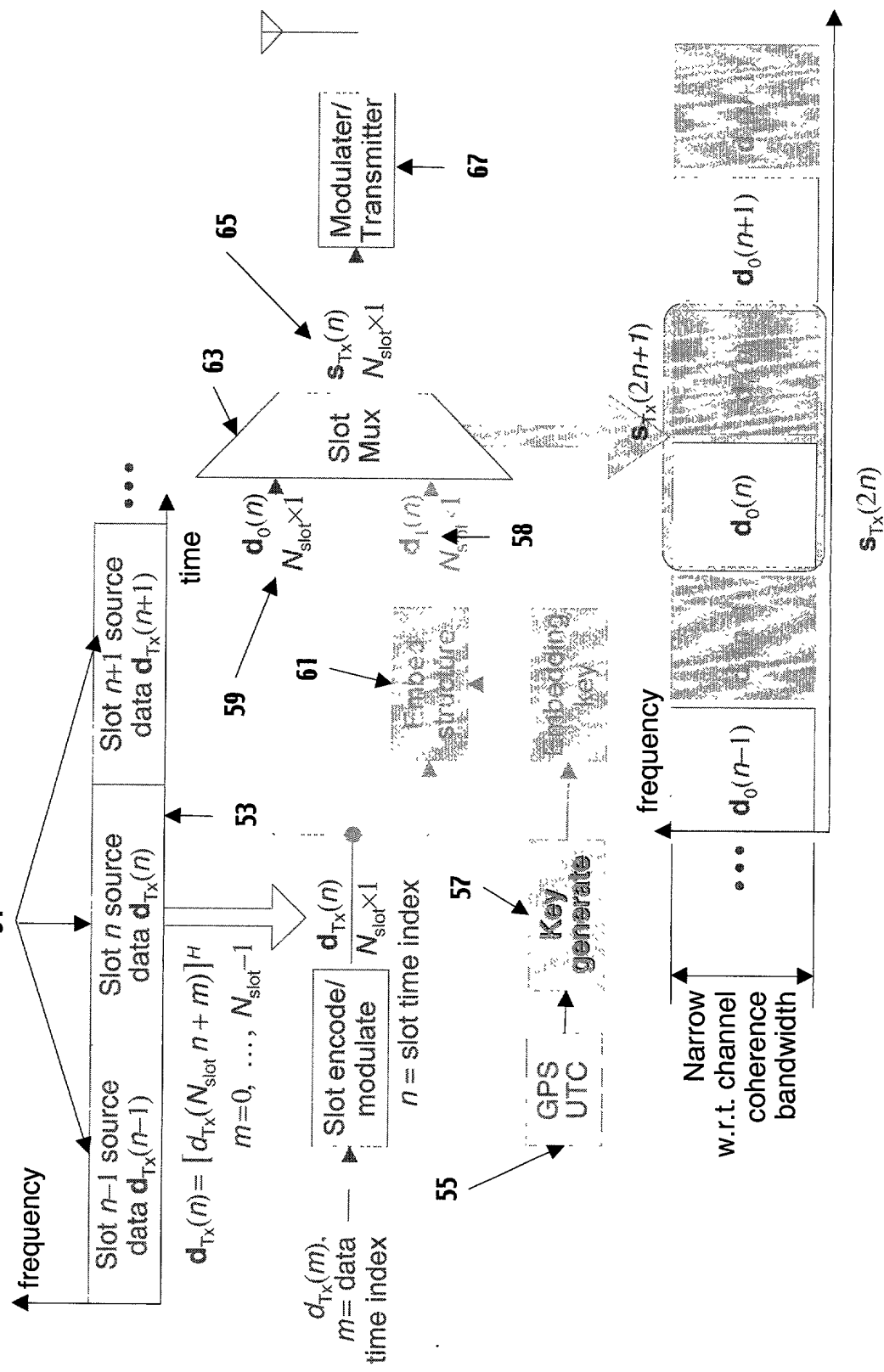


# WECN with external sources/recipients



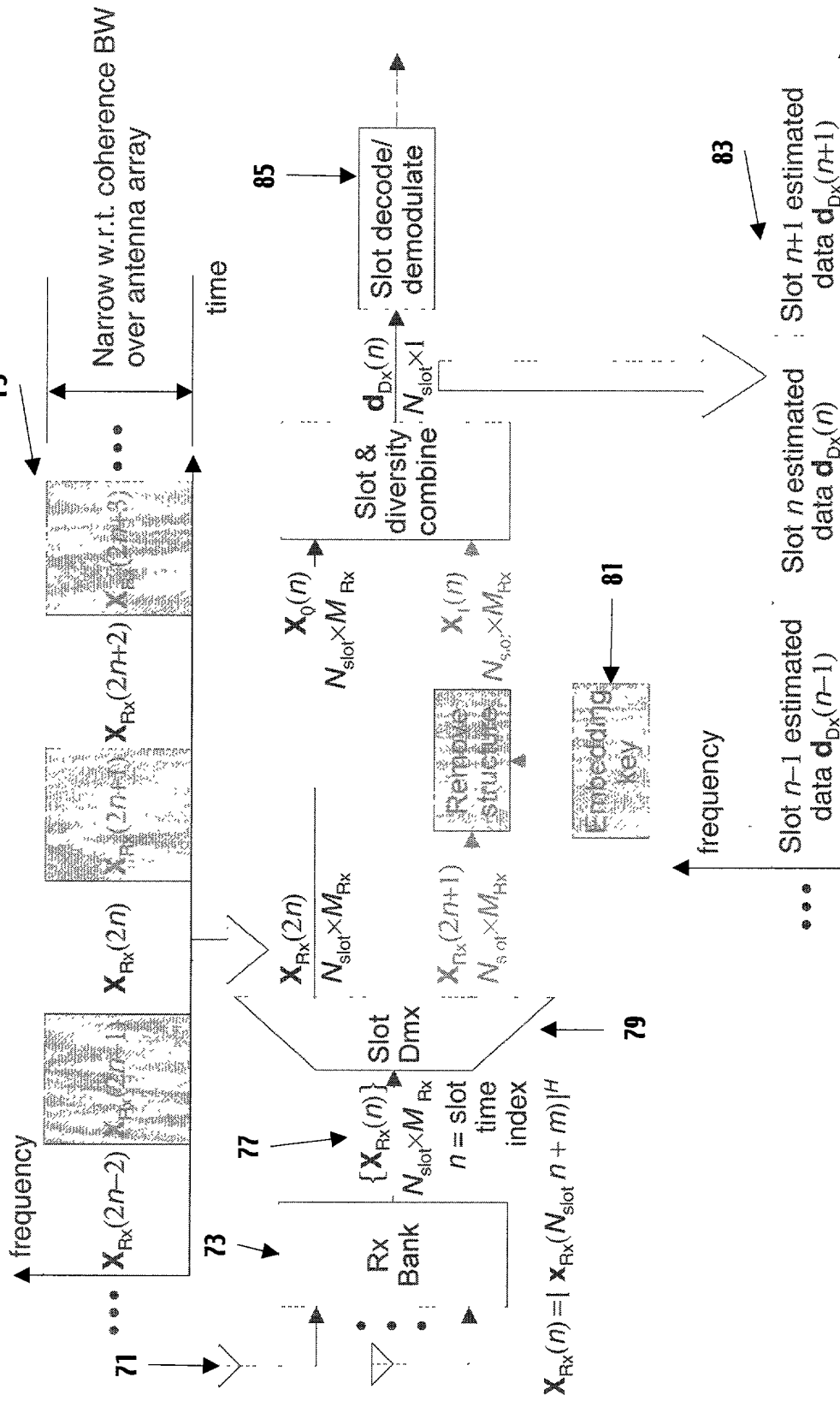
Figure

# Time-Slot Embedding



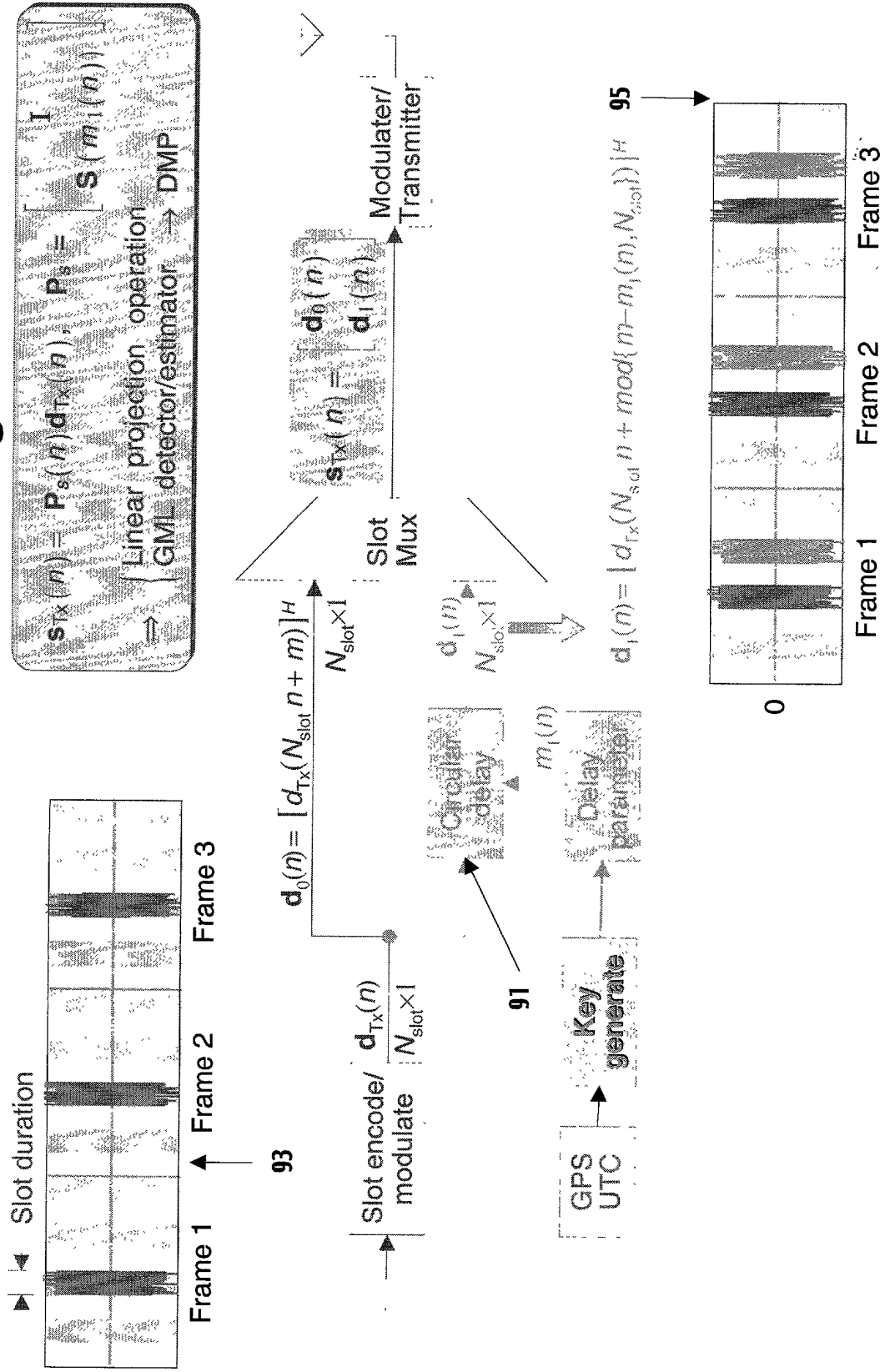
Figure

# Time-Slot Reception/Removal 75



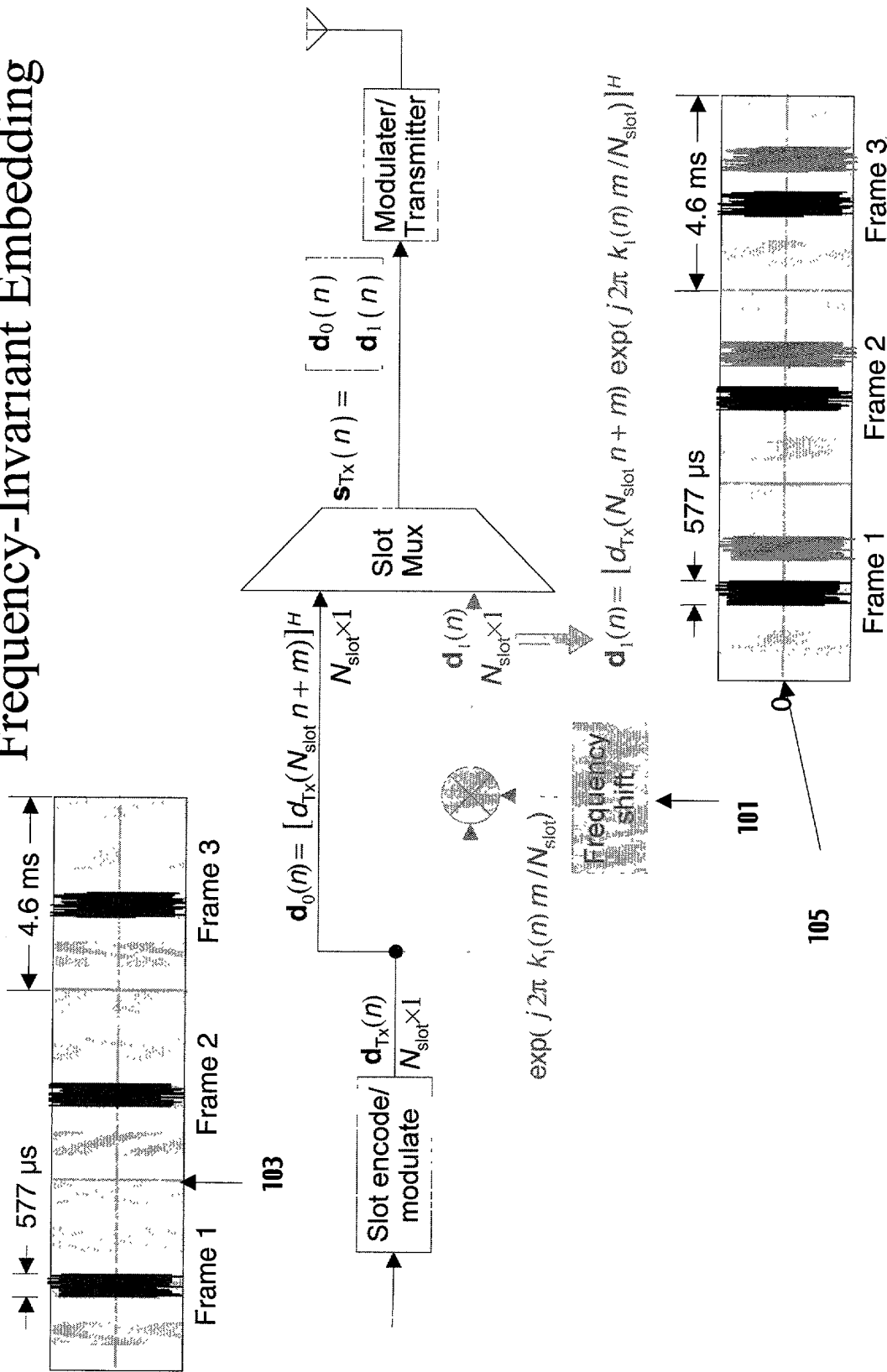
Figure

# Delay-Invariant Embedding



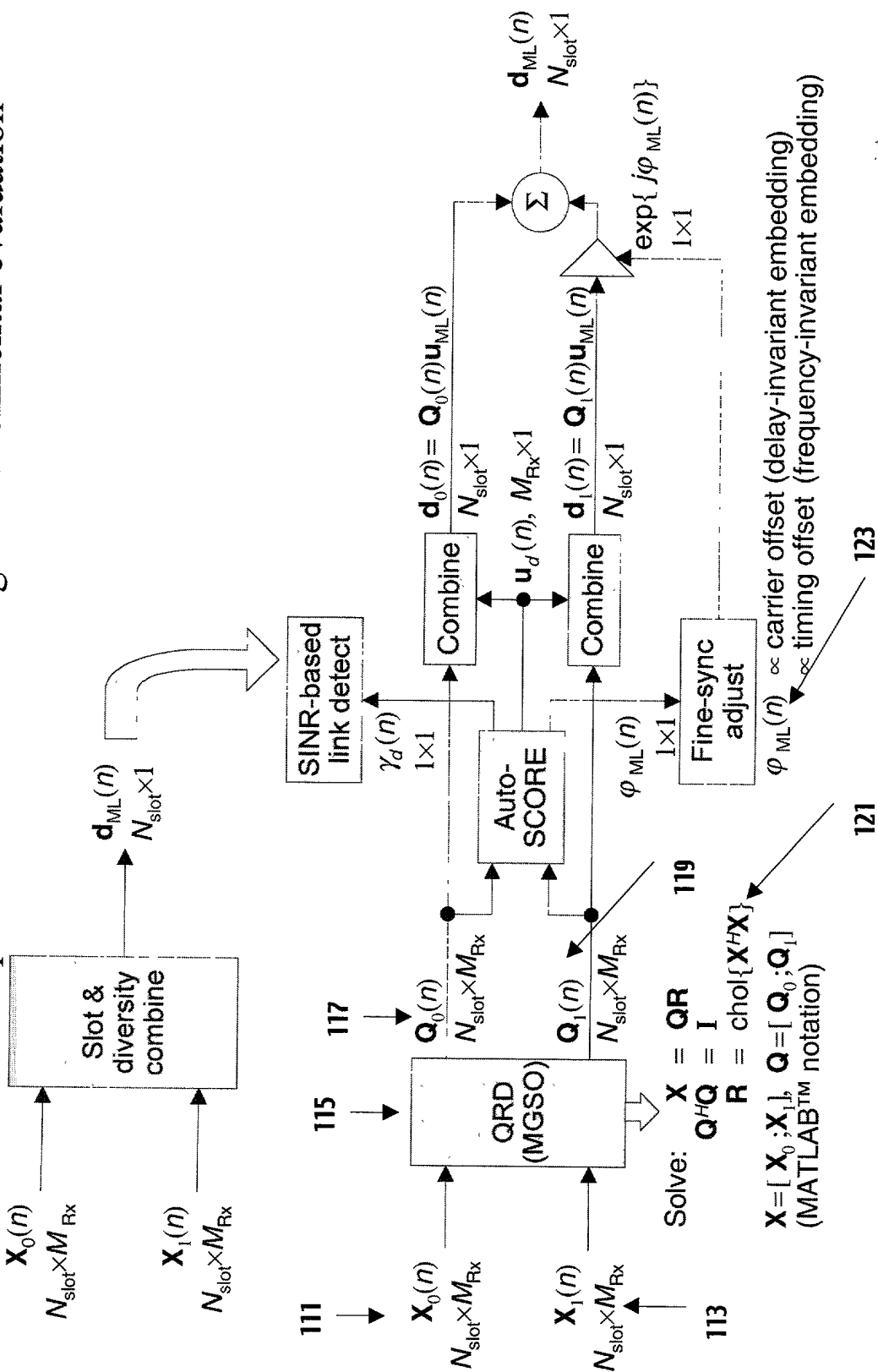
Figure

# Frequency-Invariant Embedding



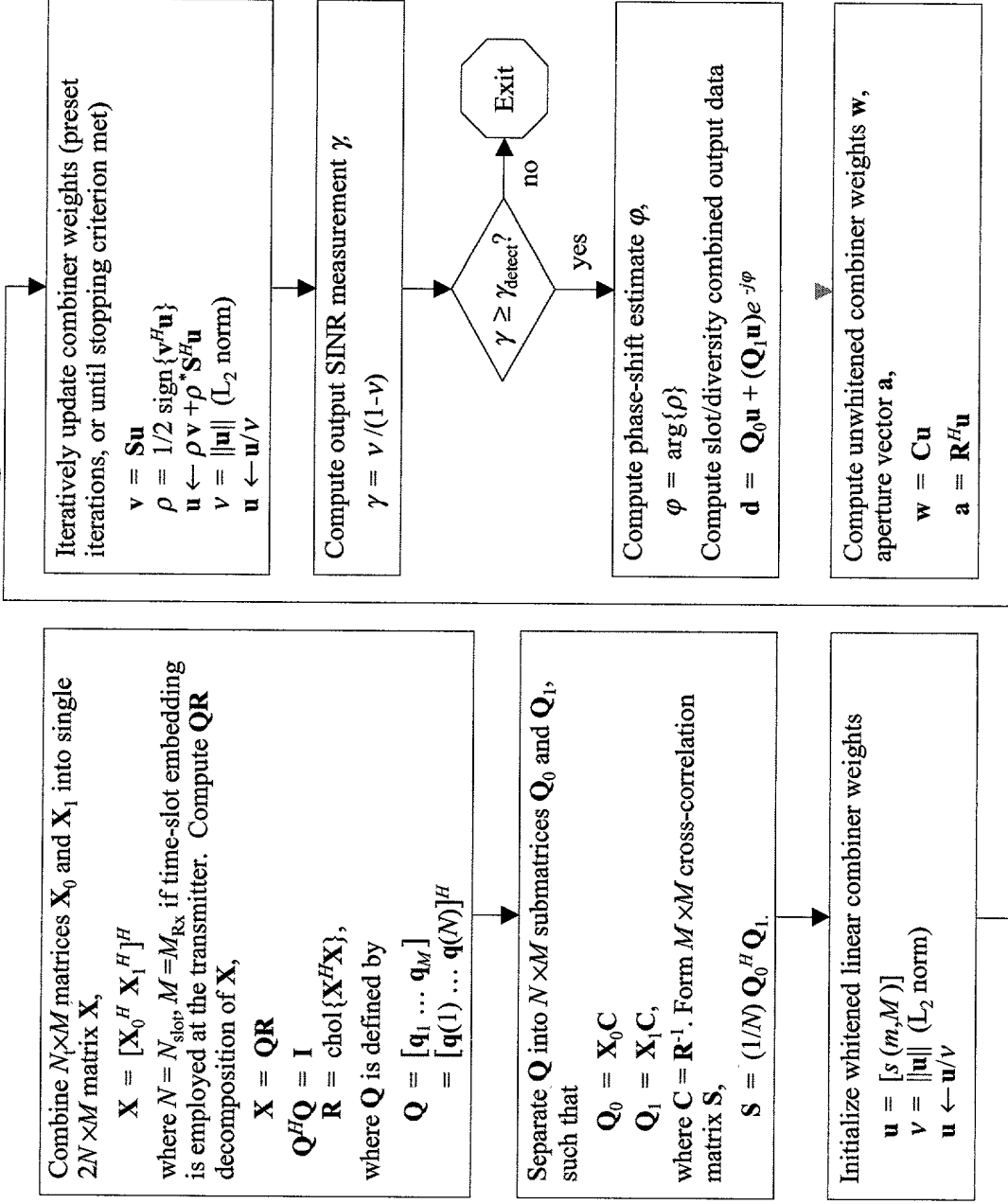
Figure

# Auto-SCORE Adaptation - Data whitening & environmental evaluation



Figure

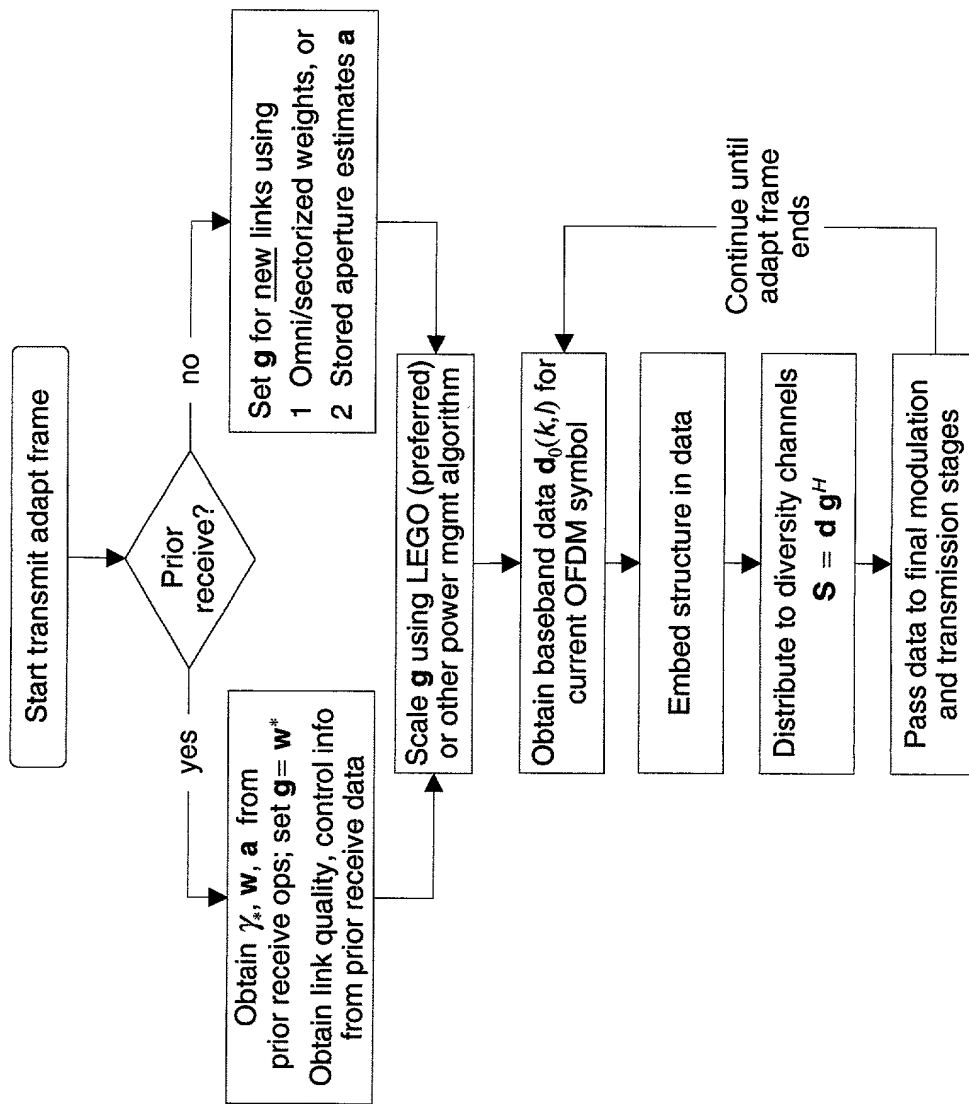
# Single-Link Auto-SCORE Algorithm - Software



Figure

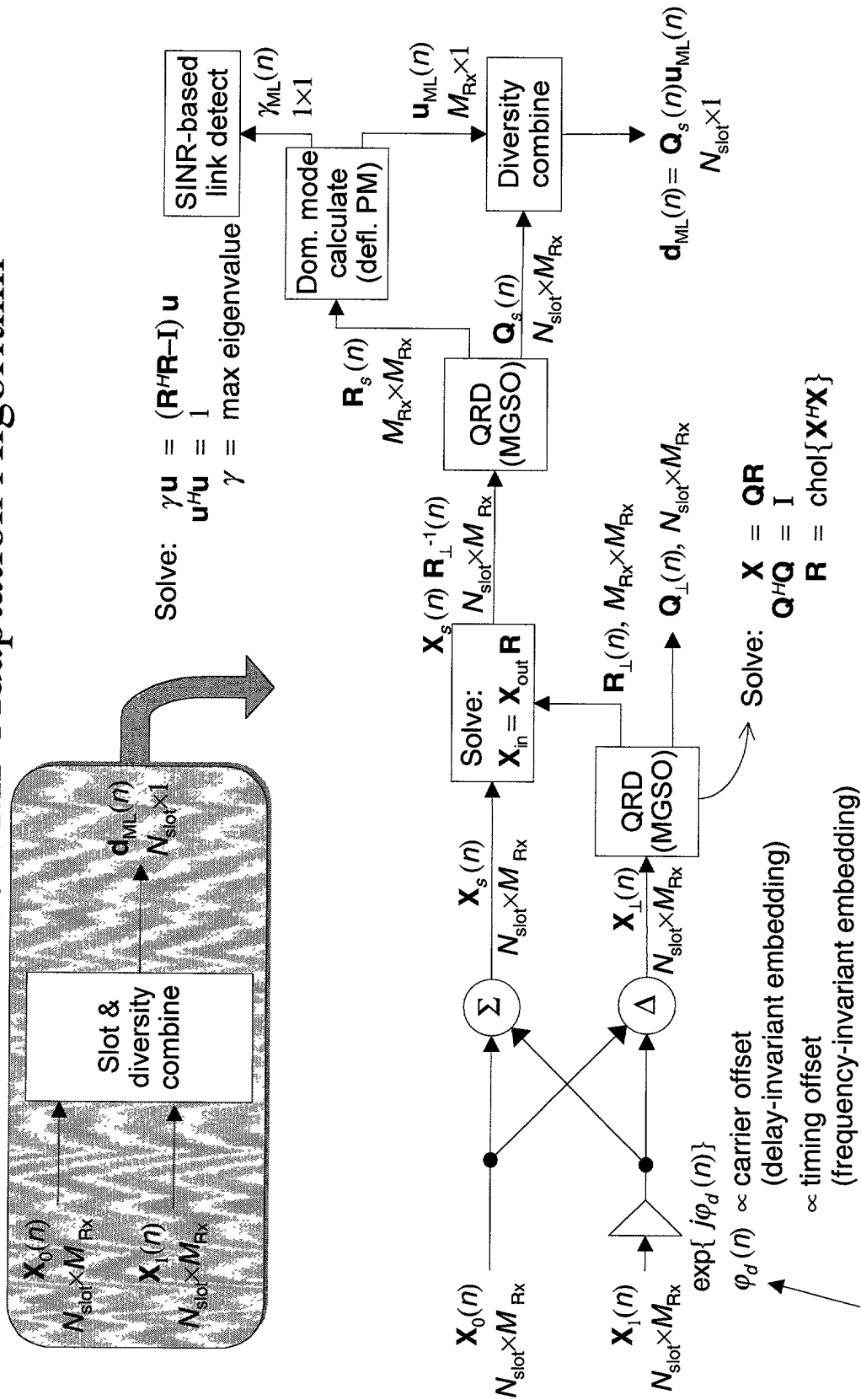


# Single-Link Transmitter Flow Diagram



Figure

# Alternative DMP Adaptation Algorithm



Figure

# alternative converging embedded-signal-differentiation algorithms

## Dominant-Mode Prediction

Solve:  $\gamma \mathbf{u} = (\mathbf{R}^H \mathbf{R} - \mathbf{I}) \mathbf{u}$   
 $\|\mathbf{u}\| = 1$  ( $L_2$  norm)  
 $\gamma = \max \text{eigenvalue}$

## Optimization Algorithm

Initialize:  $\mathbf{u} = r(M, M) [r^*(M, 1) - 1]$   
 $\gamma = \|\mathbf{u}\|$  ( $L_2$  norm)  
 $\mathbf{u} \leftarrow \mathbf{u} / \gamma$

Iterate:  $\mathbf{v} = \mathbf{R} \mathbf{u}$   
 $\mathbf{u} \leftarrow \mathbf{R}^H \mathbf{v} - \mathbf{u}$   
 $\gamma = \|\mathbf{u}\|$  ( $L_2$  norm)  
 $\mathbf{u} \leftarrow \mathbf{u} / \gamma$

## Auto-SCORE

Solve:  $\mathbf{v}(\varphi) \mathbf{u} = \mathbf{S}(\varphi) \mathbf{u}$   
 $\mathbf{S}(\varphi) = 1/2(\mathbf{S}e^{j\varphi} + \mathbf{S}^H e^{-j\varphi})$   
 $\|\mathbf{u}\| = 1$  ( $L_2$  norm)  
 $\mathbf{v}(\varphi) = \max \text{eigenvalue}$   
 $\varphi = \arg \max_{\varphi} \mathbf{v}(\varphi)$

## Optimization Algorithm

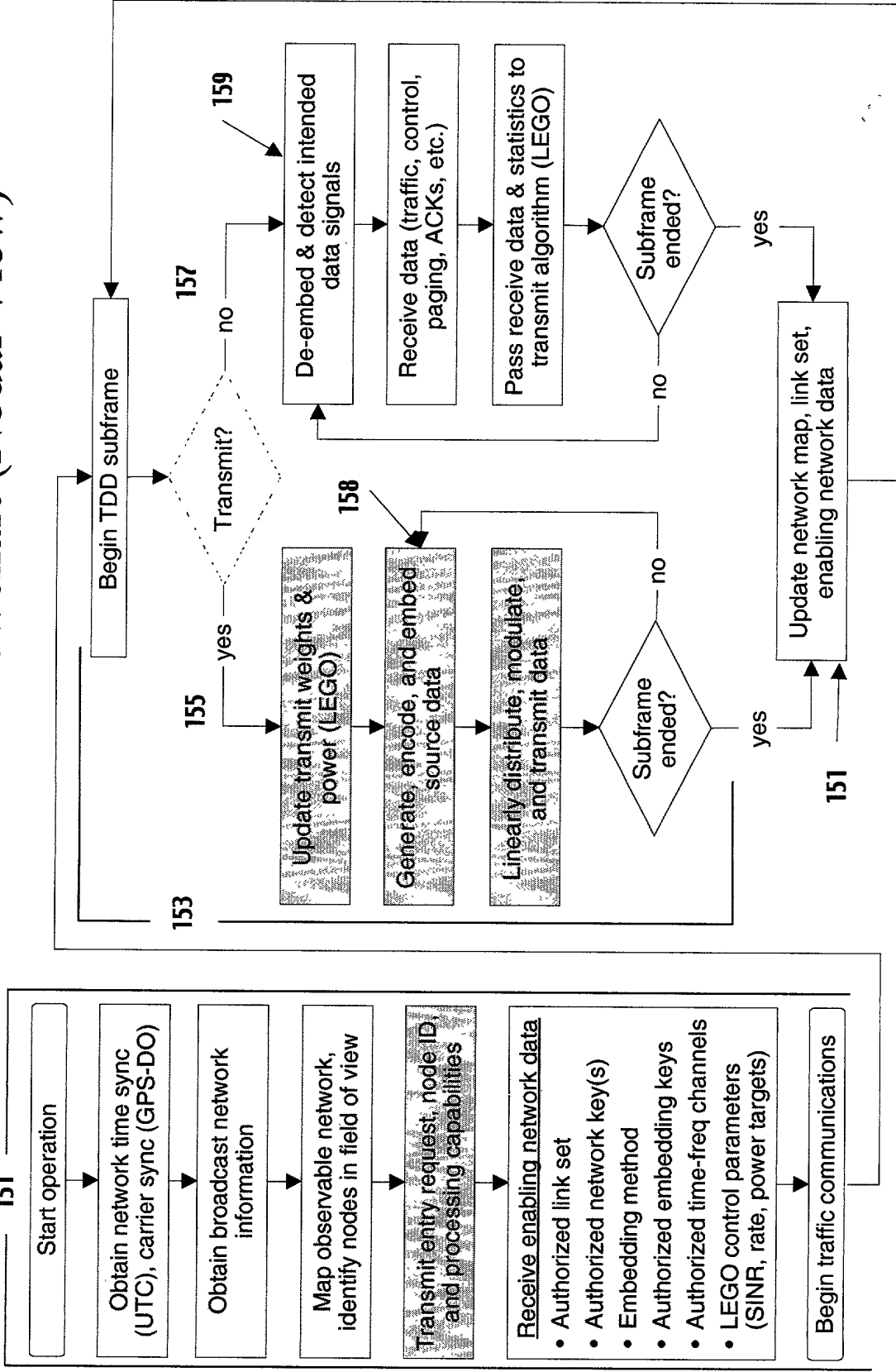
Initialize:  $\mathbf{u} = [s(m, M)]$   
 $\mathbf{v} = \|\mathbf{u}\|$  ( $L_2$  norm)  
 $\mathbf{u} \leftarrow \mathbf{u} / \mathbf{v}$

Iterate:  $\mathbf{v} = \mathbf{S} \mathbf{u}$   
 $\rho = 1/2 \text{ sign}\{\mathbf{v}^H \mathbf{u}\}$   
 $\mathbf{u} \leftarrow \rho \mathbf{v} + \rho^* \mathbf{S}^H \mathbf{u}$   
 $\mathbf{v} = \|\mathbf{u}\|$  ( $L_2$  norm)  
 $\mathbf{u} \leftarrow \mathbf{u} / \mathbf{v}$

Finalize:  $\varphi = \arg\{\rho\}$   
 $\gamma = \mathbf{v} / (1 - \mathbf{v})$

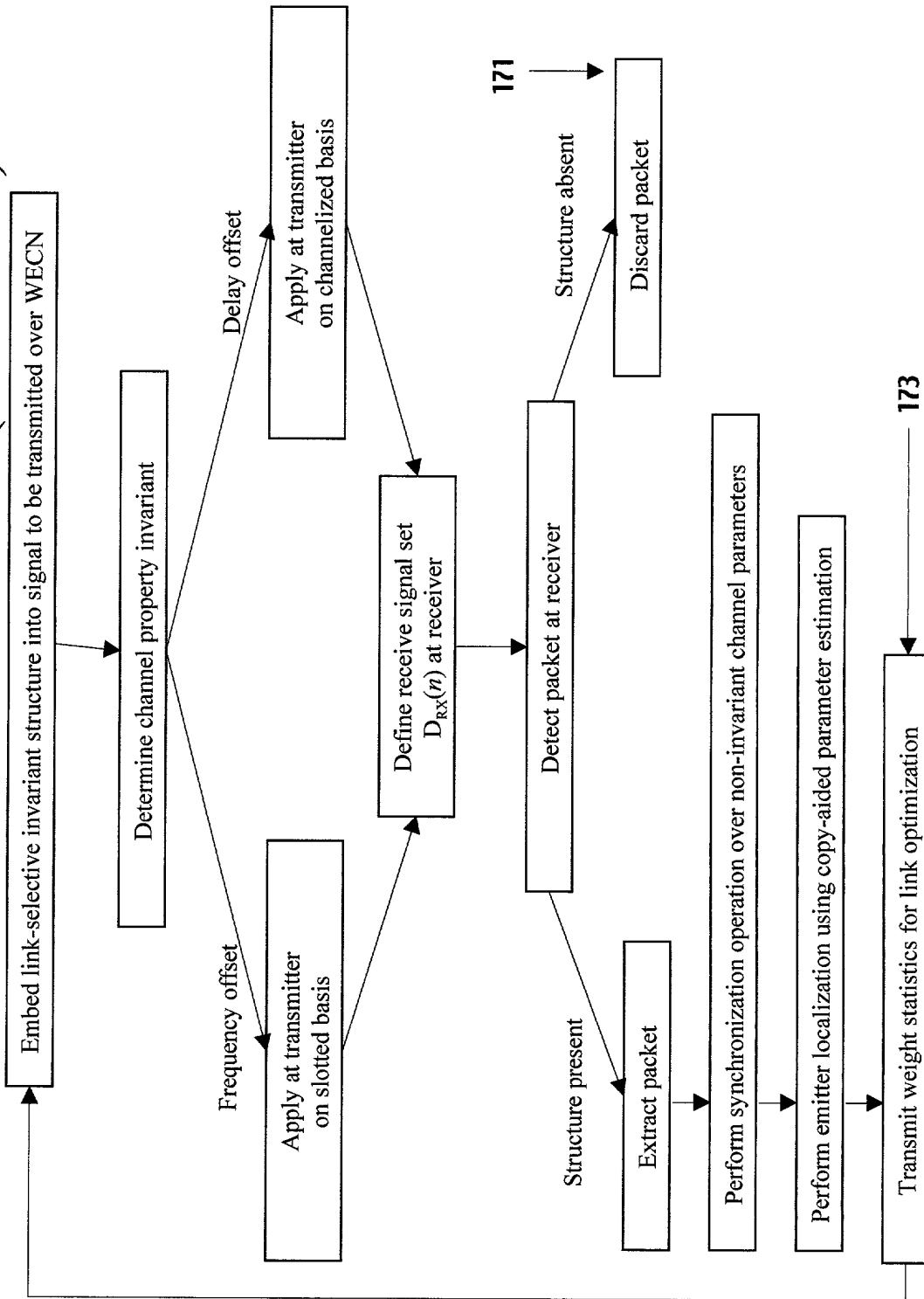
Figure

# 151 Embedded Invariance Flowchart (Nodal View)



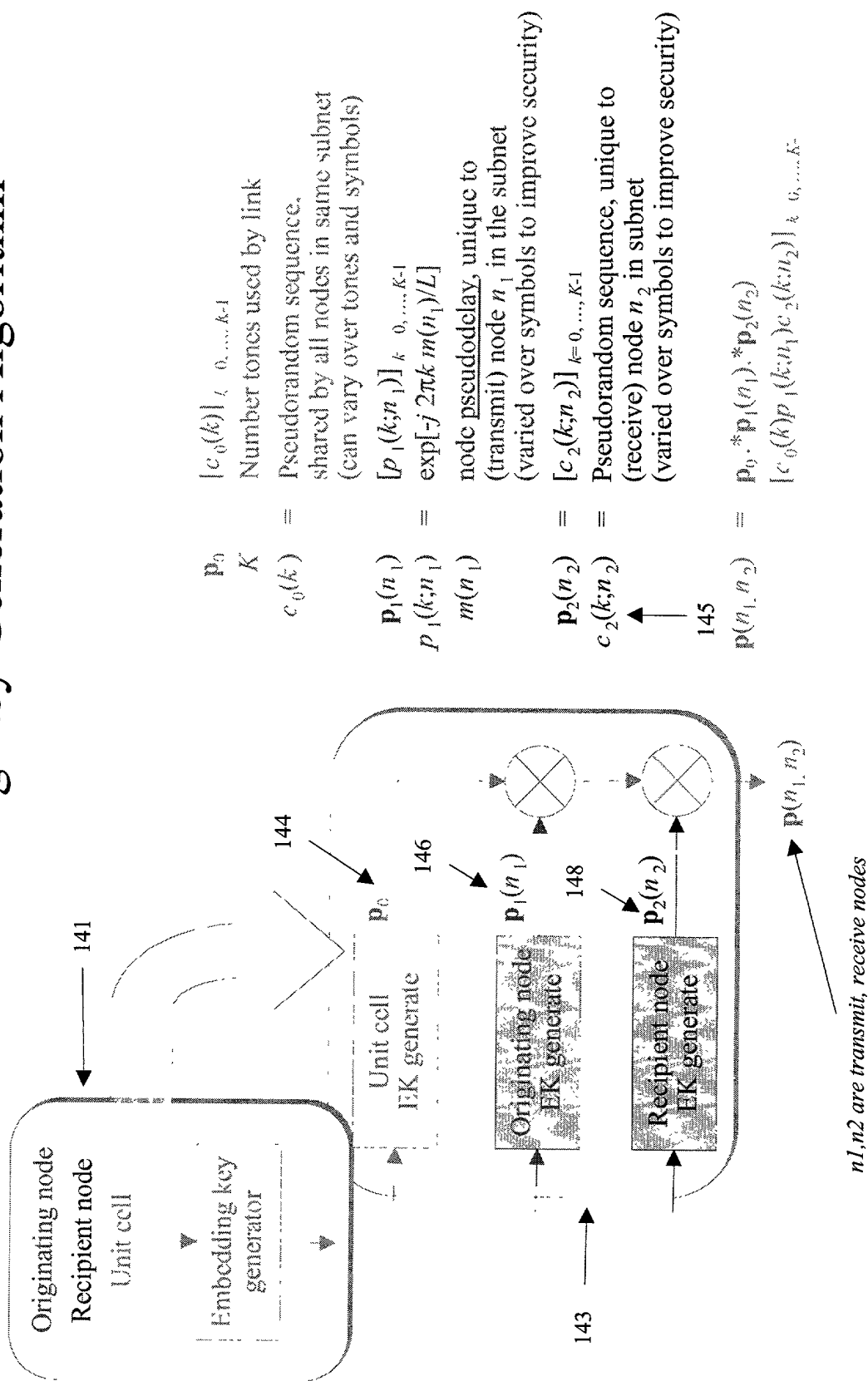
Figure

# Embedded Invariance Flowchart (Link View)



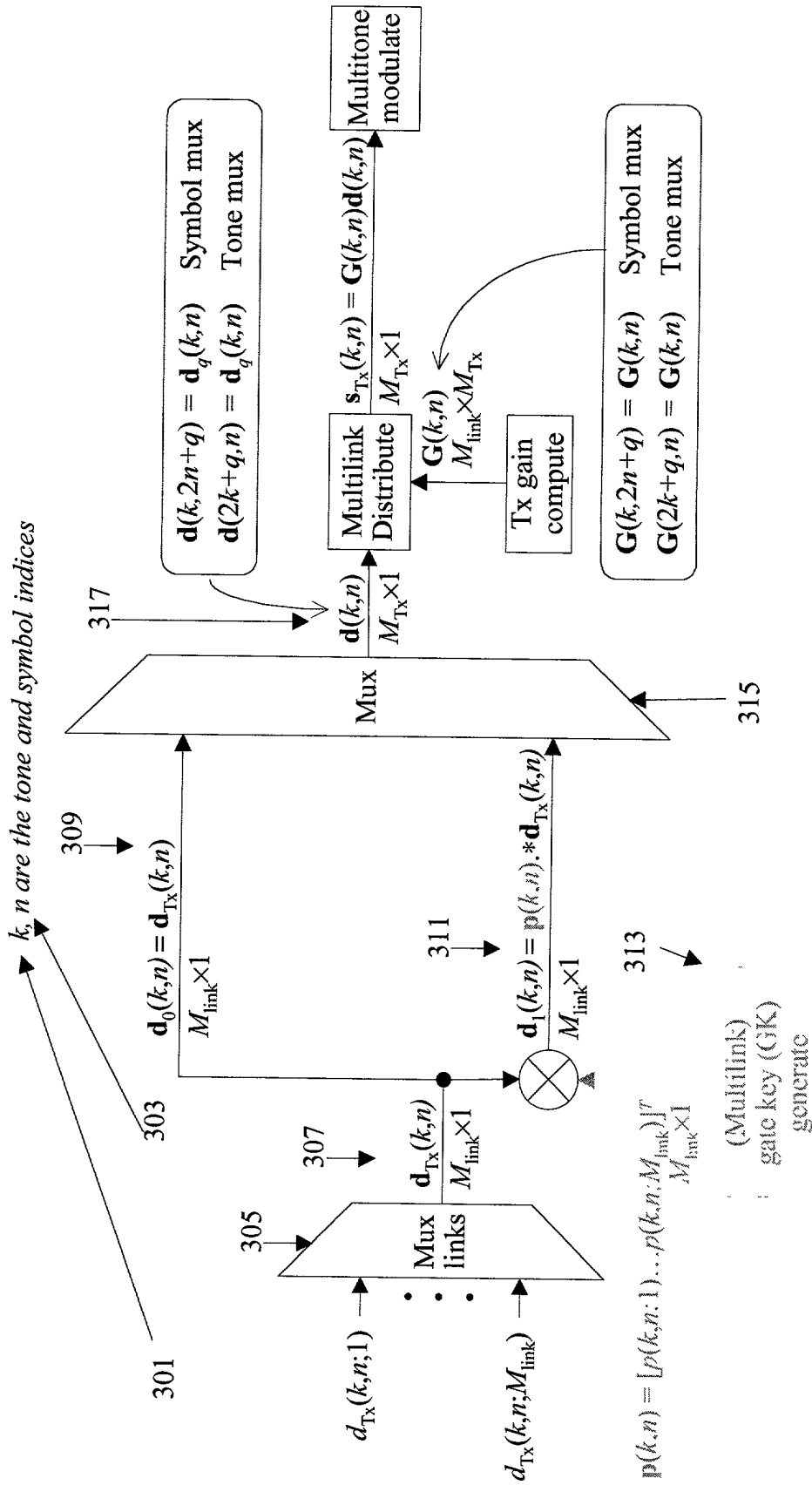
Figure

# Multilink Embedding Key Generation Algorithm



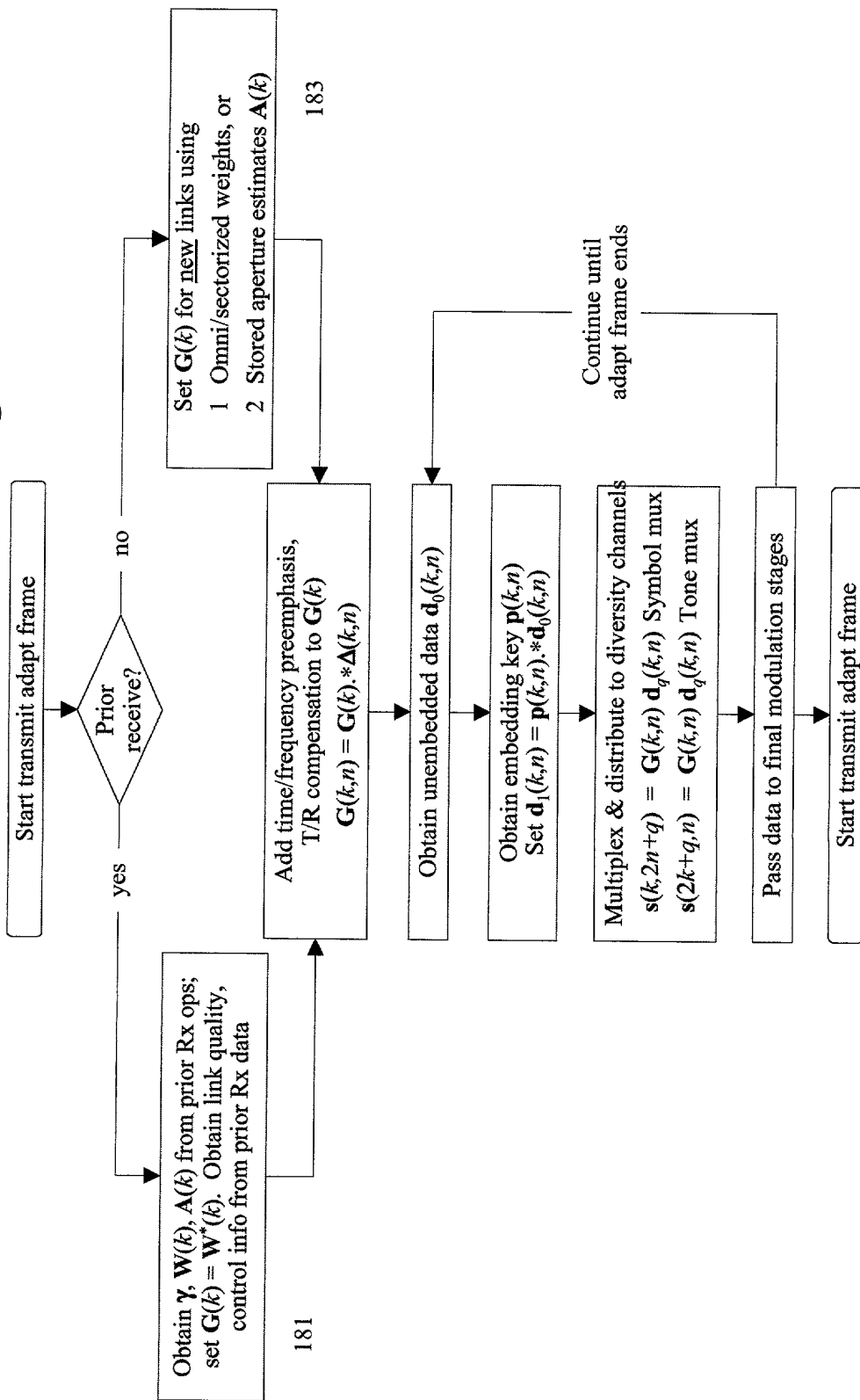
Figure

# Multilink Transmit Embedding Hardware (Node $n_l$ )



Figure

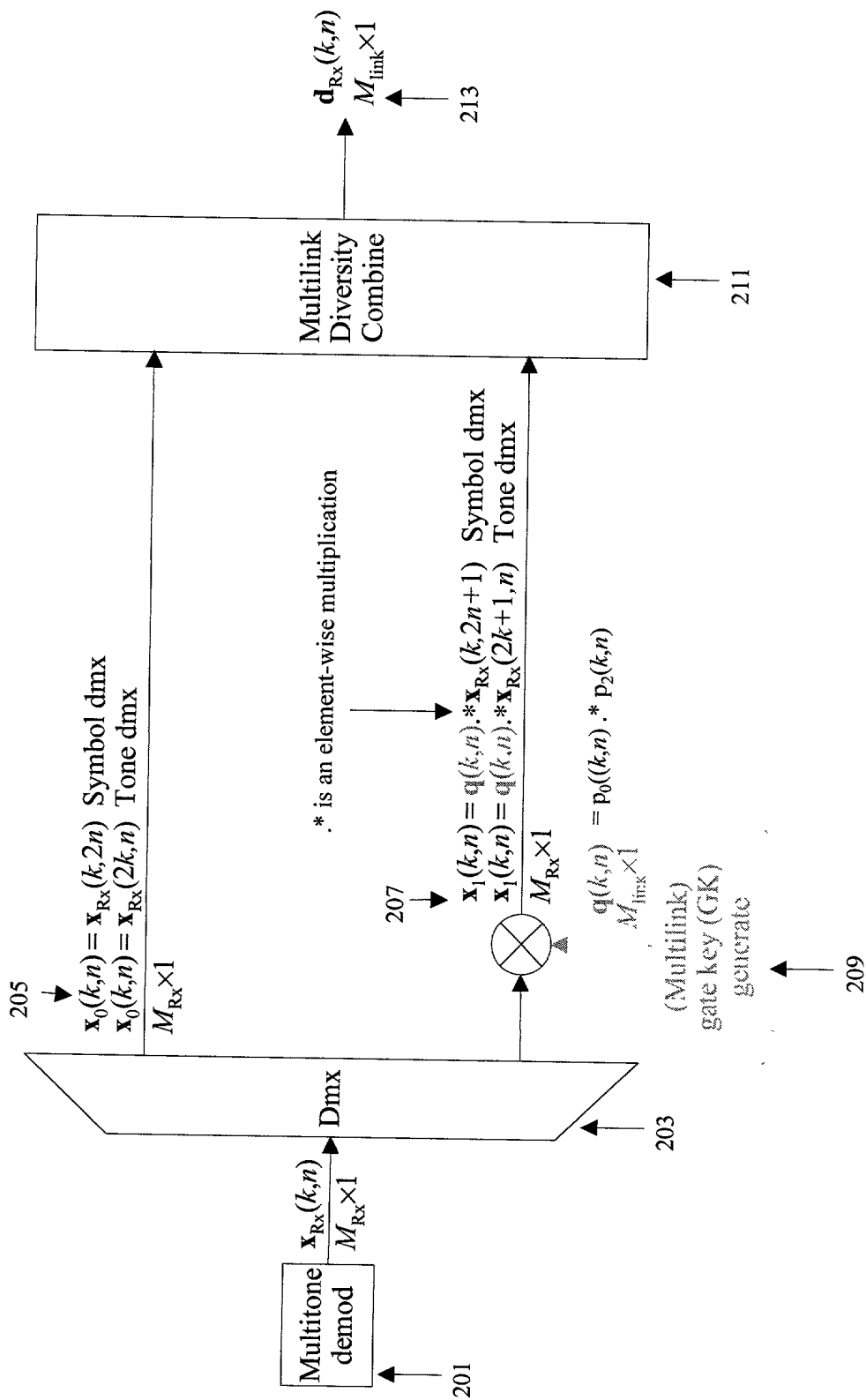
# Multilink Embedding Flow Diagram



Figure

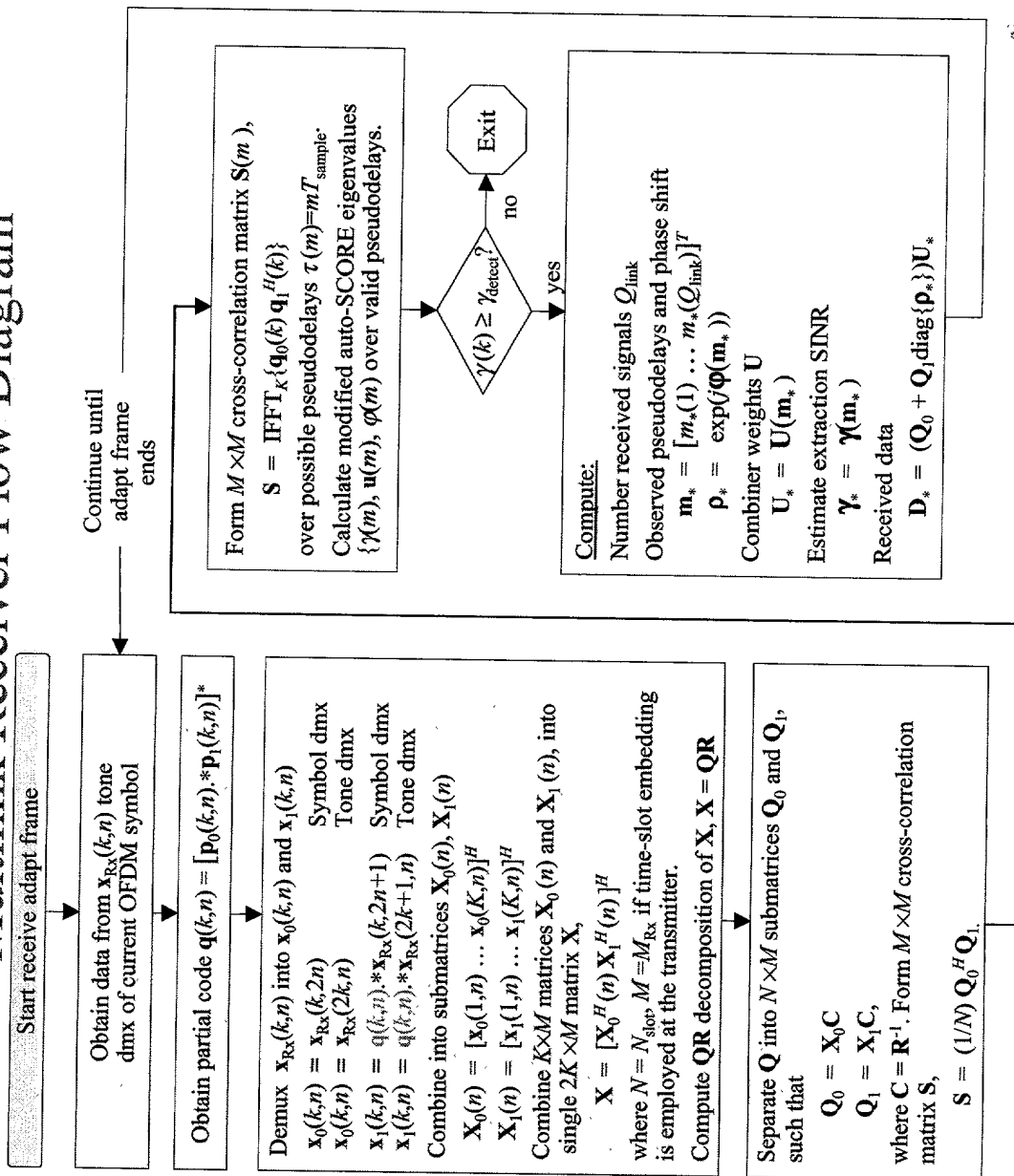


# Multilink Receive Embedding Hardware



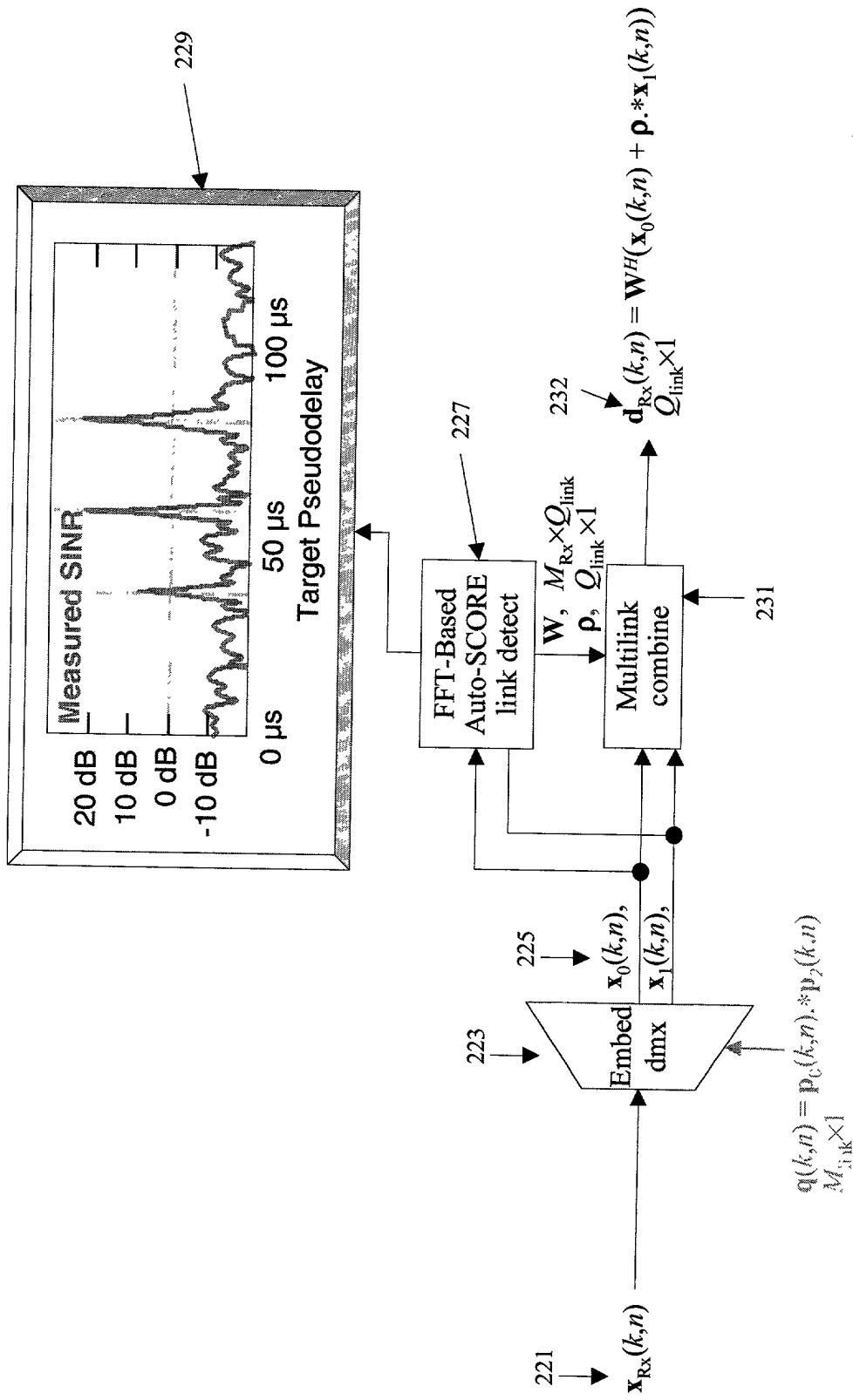
Figure

# Multilink Receiver Flow Diagram



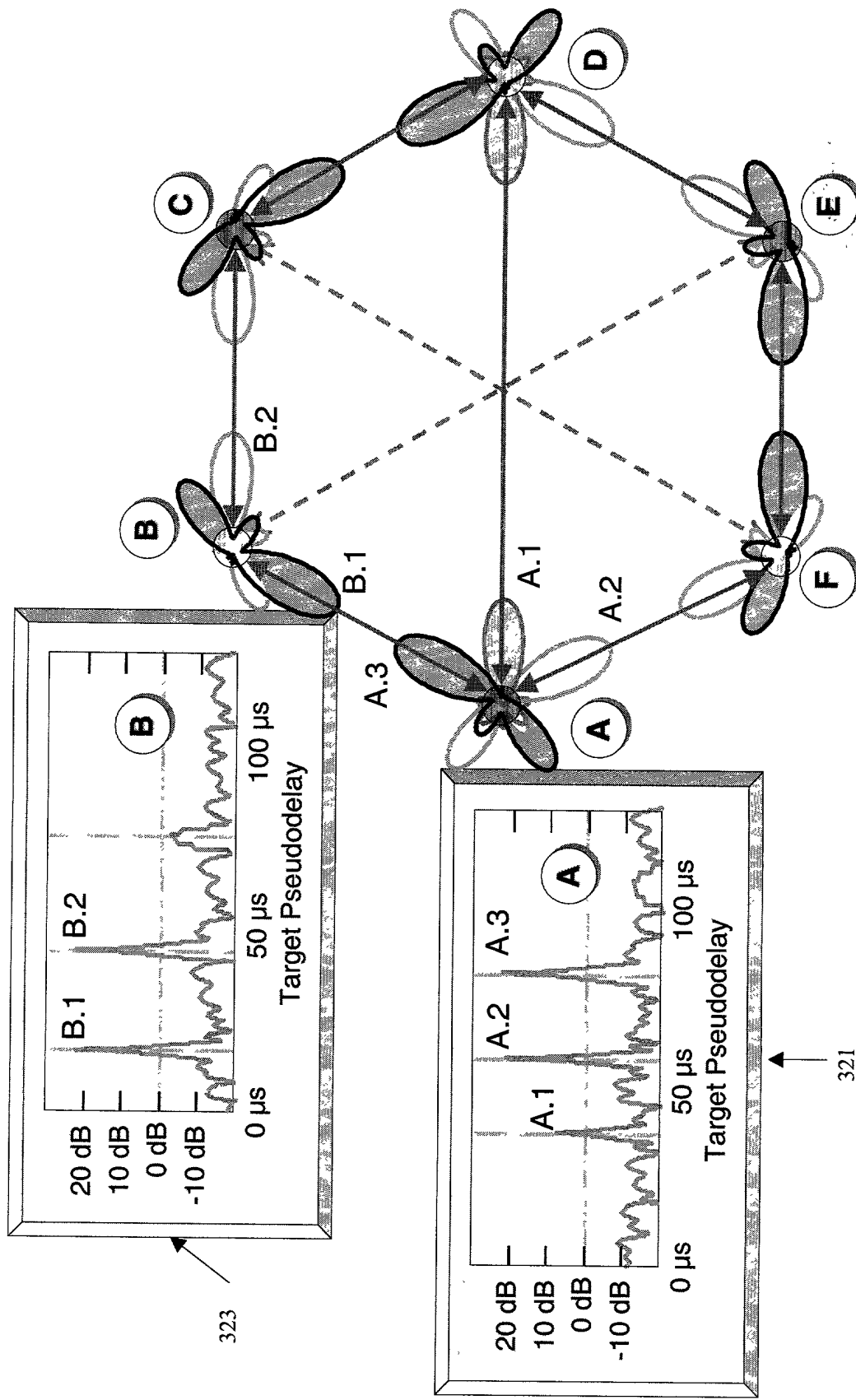
Figure

# Link Detection, Separation Operation



Figure

# Pseudodelay Plots and Antenna Patterns



Figure